# CHARACTERISTICS OF WELL-WRITTEN REQUIREMENTS

## *Requirements Characteristics*

| | |
|---|---|
| **Needed** | A requirement is a statement of something someone needs. It distinguishes between a need and a want. A requirement that is not necessary is not a good requirement. |
| **Verifiable** | A requirement must state something that can be verifiable by inspection, analysis, test, or demonstration. Identify how to prove that a product meets the requirement when writing or reviewing a requirement. |
| **Attainable** | A requirement must be attainable within foreseeable budget and schedule, and must be technically feasible. This is particularly important for the technical requirements. Higher level "Operational Requirements" may be developed without assurance of budget or schedule, but they must be technically feasible |
| **Clear** | A requirement expresses a single thought. It cannot be misunderstood. It is concise, simple, and grammatically correct. |

(Portions of content adapted from Customer-Centered Products, Ivy F. Hooks & Kristin A. Farry, American Management Association, 2001, and Requirements Best Practices, Compliance Automation, Inc., 2005.)

# *Tips for Writing Requirements*

| Suggestion | Description | Example |
|---|---|---|
| Use standard requirements terminology:<br><br>• Use of Shall, Will, and Should | • Use ***shall*** in stating requirements<br>• Use ***will*** in stating facts<br>• Use ***should*** in stating goals.<br><br>Shall is the flag that identifies requirements. Each shall is contractually binding and drives the development budget. The use of shall is especially important when requirements go to an external or contracted provider. | Example:<br><br>The ABS system **shall** illuminate a warning light in the event of … |
| State ***what***, <u>not</u> ***how.*** | Requirements state what is needed, not how to provide it.<br><br>Remove implementation from requirements. Ask why you need each requirement. If the answer takes you back to a more fundamental requirement, you were stating a 'how' not a 'what'.<br><br>Eliminate operation descriptions. Instead, state the requirement. Requirements that state "the user shall", "the forecaster shall", or "the operator shall" are almost always operational descriptions, not requirements.<br><br>Ensure a requirements statement is correct and complete. | Correct:<br>The XYZ system shall measure room temperature.<br><br>Incorrect:<br>The XYZ system shall use a 4-wire thermo-couple to measure room temperature.<br><br>*And*<br><br>Correct:<br>The stereo amplifier shall have a control for setting the volume level.<br><br>Incorrect:<br>The user shall be able to adjust the amplifier volume. |

| Suggestion | Description | Example |
|---|---|---|
| Use correct, unambiguous terms and good grammar | There must be one, correct, understanding of a requirement. Incorrect and ambiguous requirements terms cause budget and schedule problems. Poor writing can obscure the most necessary requirement. If you can't understand it, your developers probably can't either. | Ambiguous terms to avoid:<br>*Support, but not limited to, etc., and/or, may, could.*<br><br>Correct:<br>The stereo amplifier shall provide outputs for two additional speakers at full-rated power.<br><br>Incorrect:<br>The stereo amplifier shall support additional speakers.<br><br>*And*<br><br>Correct:<br>The system shall display the temperature reading to an accuracy of +-0.5 Celsius within 15 seconds of power-on.<br><br>Incorrect:<br>The system shall display accurate temperature readings within 15 seconds of power-on and/or refresh. |

| Suggestion | Description | Example |
|---|---|---|
| Write verifiable requirements | Think ahead to verification. Requirements that contain subjective, unquantifiable words are not verifiable.<br><br>Ask "How will we verify or confirm that the designed and built product met the requirement?" An unverifiable requirement is an unnecessary or bad requirement. How do you verify "the product shall be safe?" | Subjective terms:<br>*User-friendly, flexible, easy, sufficient, adequate, useable, when required, if required, appropriate, fast, portable, light-weight, small, large, quickly, easily, clearly, other 'ly' words, 'ize' words.*<br><br>Correct:<br>The system shall update the display every 10 seconds.<br><br>Incorrect:<br>The system shall have a fast update to the display.<br><br>*And*<br><br>Correct:<br>The operating instructions shall meet the National Education Association's 4th-grade reading skills standard.<br><br>Incorrect:<br>The operating instructions shall be understood by operators with only a 4th-grade reading level. |

| Suggestion | Description | Example |
|---|---|---|
| Use consistent, concise language | Use the same terms throughout and be concise. | Consistent:<br>The maximum *vehicle* net weight shall be 2 tons.<br>*And*<br>The *vehicle* shall have 2 axles.<br><br>Inconsistent:<br>The maximum *vehicle* net weight shall be 2 tons.<br>*And*<br>The *truck* shall have 2 axles. |
| Identify missing requirements | Failing to mention a requirement may be tantamount to asking the product developer to make an assumption or decision about a specific detail. If you don't specify it, you cannot complain later that it was left out.<br><br>The first defense against missing requirements is a well-developed operational concept; The second is using standard formats for requirements documents. | An project omitted a requirement specifying the system response to a message containing an erroneous or unrecognized location code. Consequently, when incorrect codes were encountered in a message, the system was coded to halt delivery of the message to all locations not just those with erroneous codes. |
| Eliminate contradictory or duplicate requirements. | One requirement cannot contradict another. | Requirement 1:<br>The maximum vehicle net weight shall be 2 tons.<br><br>Requirement 2:<br>The maximum vehicle net weight shall not exceed 4 tons. |

| Suggestion | Description | Example |
|---|---|---|
| Track traceability early in the process | Record and track relationships between levels of requirements. Document which "parent" requirement is driving a lower-level "child" requirement. Checks must be made periodically to ensure the traceability is correct and complete and that requirements flow down correctly. Lower level child requirements that do not link back to higher level parent requirements may be gold-plating or indicate a missing higher level requirement.<br><br>Traceability is crucial in change impact assessments.<br><br>Design reviews should address how the design meets each requirement. | Parent:<br>**1.119** The system shall allow the user to display a topology diagram for basins<br><br>Child:<br>**1.119.1** The system shall allow the user to display a topology diagram to show the upstream to downstream connectivity of basins in a forecast group. |
| Track the requirements owner or source | The requirements owner or source is the stakeholder specifying the requirement. The owner is knowledgeable about the need for the requirement, willing and able to defend the need, and able to assess how project changes or changes to other requirements impact the requirement. | Requirement:<br>LAMP gridded (GRIB2), point (BUFR), and text (ASCII) guidance shall be accessible to the forecast offices within 30 minutes of its production.<br><br>*Owner/Source:*<br>WFO Midland, TX |

<table>
<tr><th>Suggestion</th><th>Description</th><th>Example</th></tr>
<tr>
<td>Track rationale for each requirement</td>
<td>Rationale is an explanation of why a requirement exists, any assumptions made in writing the requirement, or other information such as design decisions useful to managing the requirement throughout the life of the project.<br><br>Capture the rationale as requirements are written. Rationale can expose incorrect facts and wrong assumptions.</td>
<td>Requirement:<br>The maximum truck height shall be 14 feet.<br>Reason:<br>Ninety-nine percent of all U.S. interstate highway overpasses have a 14-foot or greater clearance.<br>Assumption:<br>The truck will be used on U.S. interstate highways for long-haul freight.</td>
</tr>
<tr>
<td>Prioritize each requirement</td>
<td>Indicating the relative importance of each requirement early in the project provides options for managing requirements additions and risks, and provides guidance in making design trade-off decisions.<br><br>A three tiered prioritization classification is recommended:
<table>
<tr><th>Priority Level</th><th>Description</th><th>When Needed</th></tr>
<tr><td>High</td><td>Essential and non-negotiable. It must be met to obtain the basic capability.</td><td>Initially or right now</td></tr>
<tr><td>Medium</td><td>Useful, negotiable, or slightly deferrable. Not meeting it results in a limited or degraded capability.</td><td>A little later</td></tr>
<tr><td>Low</td><td>Desirable. Not meeting it results in some capability or ease of use being degraded.</td><td>Someday</td></tr>
</table>
</td>
<td>Requirement 1:<br>The maximum truck height shall be 14 feet.<br>Priority: High<br><br>Requirement 2:<br>The truck trailer exterior shall be decorated on both sides with the company logo having a dimension of 6 ft by 8 ft.<br>Priority: Medium<br><br>Requirement 3:<br>The truck cab shall be outfitted with furnishings decorated using the company logo color scheme.<br>Priority: Low</td>
</tr>
</table>

<table>
<tr><th>Suggestion</th><th>Description</th><th>Example</th></tr>
<tr><td>Perform the 4 ½ Step Requirements Review Process on the final draft of the requirements<br><br>Adapted from Requirements Best Practices, Compliance Automation, Inc., 2005</td><td>
<table>
<tr><th>Step</th><th>Review For</th><th>Who</th><th>How Many</th></tr>
<tr><td>1. Editorial</td><td>Editorial</td><td>Person with editorial skills</td><td>1 - 2</td></tr>
<tr><td>2. Goodness</td><td>Goodness</td><td>Knows rules; some technical knowledge</td><td>2 - 3</td></tr>
<tr><td>3. Content</td><td>Content</td><td>All stakeholders</td><td>As many as needed</td></tr>
<tr><td>4. Risk</td><td>Risk</td><td>Technical and management knowledge</td><td>2 – 3</td></tr>
<tr><td>4 ½. Editorial</td><td>Editorial</td><td>Person with editorial skills</td><td>1 - 2</td></tr>
</table>
</td><td></td></tr>
</table>